DETERMINE DENSITY AND COMPOSITION OF SMALL MAMMAL PREY BASE ON SELECTED MEXICAN SPOTTED OWL HOME RANGES

Final Report
Cooperative Agreement 28-CO-~~528~~ 538

Submitted To

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INTRODUCTION

The Mexican spotted owl (Strix occidentalis lucida) is one of three subspecies of spotted owls in the United States (AOU 1957). It occupies forested and canyon areas of southern Colorado, Arizona, New Mexico, Utah, and Mexico. The northern subspecies (S.o. caurina) was listed as threatened throughout its range by the U.S. Fish and Wildlife Service on June 22, 1990 (Anonymous 1990). The Mexican spotted owl was classified as a sensitive species on all National Forests in Arizona and New Mexico in 1989.

Interim policy guidelines for Mexican spotted owl habitat management were updated on June 25, 1990. The USFWS currently classifies it as a Candidate 2 species, or one that may be appropriate for listing when more information is obtained (Jolly 1989). This may change in December 1990, when the Service will make a decision on a 1989 petition for threatened listing (Anonymous 1990). These actions have been taken due to a lack of knowledge about the owls and the possibility of decreasing suitable habitat areas. Relatively little research has been done on the Mexican subspecies compared to the fairly extensive ecological, biological, and habitat based studies done on the Northern race (Forsman et al. 1984, Dawson et al. 1987, Carey 1985). These studies have demonstrated a need for extensive old-growth habitat areas, but why this habitat is critical is unknown.

A number of hypotheses have been generated to explain this old growth dependence, several of which involve prey availability or abundance. Others are concerned with temperature, predation, competition, and availability of suitable nest sites (Carey 1985). Testing of these hypotheses would provide insight into the spotted owl/old growth relationship, and would be helpful in formulating spotted owl management plans and policies.

Attempts to maintain viable populations of spotted owls could lead to large losses in timber sale revenue and timber related jobs (Blondin 1989). As mandated by the National Forest Management Act (1976) a suitable habitat must be retained to insure population maintenance. With one nesting pair requiring up to 2000 acres of valuable old growth land (Ganey 1988), the conflicts with the timber industry are considerable. Although the conflict is more apparent in the Pacific Northwest, it is also important in northern Arizona. Almost 55% of the known spotted owls are in areas of active or planned timber sales, while 30% are on unprotected timber lands (Ganey 1988).

This study was designed to determine if there is a prey species factor involved in the spotted owl/old growth dependence, either in actual abundance of prey items, or in their availability to the owls. The objectives are:

1. To determine the preferred prey species of spotted owls in northern Arizona.

2. To determine the relative abundance of the prey species in two Spotted Owl Management Areas (SOMA) in core and non-core areas. The core is defined as the area of the home range which receives the highest amount of animal use.

LITERATURE REVIEW

The spotted owl (*Strix occidentalis*) is a medium sized forest owl (Voous 1989). The three subspecies recognized by the American Ornithologists Union are differentiated by plumage coloration and geographic location (AOU 1957). The Northern spotted owl (*S.o. caurina*) is found primarily in old-growth Douglas-fir forests of coastal British Columbia and south through western Washington and Oregon (Forsman et al. 1984, Johnsgard 1988). The California spotted owl (*S.o. occidentalis*) is found in the Sierra Nevadas and other southern California coastal range areas (Johnsgard 1988). The Mexican spotted owl (*S.o. lucida*) inhabits forested areas and canyons of southern Colorado, Arizona, New Mexico, Utah, and Mexico (Johnsgard 1988).

History

Prior to the research done by Ganey (1988), little was known about the owl in Arizona. A review of the literature yielded reports on sightings and nest locations (Swarth 1908, Visher 1910, Ligon 1926, Huey 1930, 1932, Campbell 1934) and some notes on prey items (Huey 1913, 1932, Ligon 1926, Steele 1927, Marshall 1942), but no biological, ecological or habitat information. It is important to note that Dawson et al. (1987) believed that *S.o.lucida* may be rarer than the other subspecies.

Habitat

Old-growth forests are the preferred habitat of Northern spotted owls in the Pacific Northwest, with 98% of the known locations in old-growth Douglas-fir forests (Forsman et al. 1984). Mexican spotted owls exhibit a similar preference, but will utilize more habitat types and seral stages, due to the increased variability in habitats within its range (Ganey 1988). Ganey (1988) found that the three main habitat types used were mixed conifer, ponderosa pine and deciduous riparian, and that old-growth mixed conifer was the preferred site (97%) in northern Arizona. In southern Arizona less mature forests were used if they contained associated patches of old-growth, or steep canyons with rocky cliffs (Ganey and Balda 1989). Old-growth forests are typified by well-developed, multi-storied canopies with tall dominant trees, numerous snags and an abundance of logs and wood debris (Franklin et al. 1981).

Research Focus

There has been extensive spotted owl research in the Pacific Northwest and the data has illustrated an unexplained spotted owl/old-growth relationship (Forsman et al. 1984, Carey 1985, Gutierrez 1985a). A number of reasons for this dependence have been proposed. Carey (1985) and Gutierrez (1985a) group them into the following loosely formulated hypotheses: Availability of suitable nest sites, thermal cover, protection from predation, adaptation, and abundance and/or availability of prey. These

hypotheses are based on the characteristics of old-growth forests and how spotted owls utilize them.

Nest Site Hypothesis

This hypothesis is based on the fact that spotted owls, like most owls, do not build their own nests (Burton 1973). Therefore, they must use naturally occurring platforms within their habitat (Carey 1985, 1990, Gutierrez 1985a) or previously abandoned nests (Forsman et al. 1984). Typical nest sites have been described with the following characteristics: Large platforms in large diameter trees, high above the ground, in cavities or jagged top snags (Forsman et al. 1984, Ganey et al. 1988). These are necessary to accommodate the large size of the bird, and to provide protection for the young from terrestrial predators (Carey 1985). Old-growth provides a large number of natural nest sites due to snags, broken off tops etc. and these are generally large and high off the ground because the trees are older.

Thermal Cover Hypothesis

Barrows (1981) was the first to describe a relationship between site microclimate and heat stress in spotted owls. Their narrow geographic range and the consistency of their habitat indicated to him a relatively limited tolerance of environmental factors, which he then tested. The results of his study indicated that, compared to other owls, spotted owls are more heat intolerant, and will become stressed at lower temperatures

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(Ligon 1969). This stress was expressed by movement away from sunlit areas and perching with backs to the sun, and quantified by the temperature at which owls began gular fluttering (Barrows 1981).

Gular fluttering is an indicator of heat stress and temperatures for its onset has been documented for other species (Ligon 1969). Similar behavioral responses to increasing ambient temperatures were described in later studies (Forsman et al. 1984, Ganey et al. 1988, Ganey 1988). Temperatures collected at twelve summer roosts in Arizona averaged 5.4° C lower than in other areas (Ganey et al. 1988). The multi-storied nature of old-growth forests provides an ambient temperature gradient, resulting in cooler microclimates not found in less mature forests (Barrows 1981).

Predation Hypothesis

There is little data to support this hypothesis which is based on sightings of great horned owls (Bubo virginanus) and other raptors preying occasionally on both juvenile and adult spotted owls (Forsman et al. 1984, Ganey et al. 1985, Gutierrez et al. 1985, Miller and Meslow 1985). Spotted owls have been noted to avoid large open areas (Forsman et al. 1984, Gutierrez 1985a, Laymon 1985, Carey et al. 1990) and it is presumed that this is a behavioral response to predation, although reports are anecdotal. There are also conflicting reports of spotted owls responses to invasion of home ranges by great horned owls and

barred owls; sometimes they vacate the areas and sometimes they do not (Gutierrez et al. 1984, Gutierrez 1985a). Old-growth forests provide protection and reduce competition as great horned owls prefer a more open habitat type (Fisher 1974).

Adaptation Hypothesis

The adaptation hypothesis proposes that spotted owls have coevolved with the old-growth forest types and thus are behaviorally and physiologically dependent upon them (Carey 1985). Gutierrez (1985a) speculates it may also be influenced by evolutionary changes in predators, or that it may be some function of niche. Overall, there is much debate over this hypothesis which is impossible to test.

Prey hypotheses

Carey (1985) separates this into two components, prey abundance and prey availability. Gutierrez (1985a) proposes one combined prey hypothesis. The idea of abundance is that the preferred prey are found in greater number in the old-growth forest type. The theory of availability proposes that the prey items are no more abundant in old-growth, but are more available for capture by the owls there. A study done by Raphael and Barrett (1984) supports the abundance theory, as it determined that small mammal numbers increased with increasing stand age.

The availability theory is supported by the Forsman et al. (1984) study which describes the foraging behavior of spotted

owls as "sit and wait" predation, where the owls scan and dive for prey from an elevated perch. They were also observed pursuing prey by hopping from limb to limb. Voous (1989) states that it appears that the owls hunt through the middle canopy of the forest, rather than preying on forest floor or open field animals.

Earhart and Johnson (1970) relate the size dimorphism in sexes to hunting ability. The smaller, lighter males are able to hunt in more densely forested areas. Comparatively, the spotted owl is smaller than competing owl species and will forage in the denser areas to avoid competition (Gutierrez 1985a). Thus, old-growth provides more potential foraging perches, preferred forage areas, and non-competitive forage sites.

To test the hypotheses, research is needed in the following critical areas: demography, prey ecology, habitat requirement definition, juvenile dispersal, effects of habitat modification, inventory and monitoring, owl genetics and reproductive success, and vulnerability to predation (Gutierrez 1985a), Dawson et al. 1987). Research should focus on prey because Gutierrez (1985a) states that the inter-relationship of prey availability, abundance and distribution is probably the basis for the old-growth dependence. The other factors (thermoregulation, available nest sites etc.) probably becomes more important as habitat fragmentation occurs. Barrow's study (1985) positively relates prey size to breeding success. Finally, Gutierrez (1985b) states that prey relationships may be a major reason for

old-growth dependence, and preferred prey species should be analyzed.

Preferred Prey Items

The diets of both the Northern and California subspecies are composed primarily of large semi-arboreal rodents, but variation occurs between regions. Mammals comprise over 90% of the biomass consumed along with northern flying squirrel (*Glaucomys sabrinus*) and wood rats (*Neotoma* spp) (Forsman et al. 1984).

Reports of food items of the Mexican subspecies include insects, rodents, squirrels, other owls, and game birds (Huey 1913, 1932, Ligon 1926, Steele 1927, Marshall 1942). Fisher (1974), Ganey (1988), and Ganey and Balda (1988) state that mammals comprise over 90% of all prey items consumed. In northern Arizona wood rats, white-footed mice (*Peromyscus* spp) and voles (*Microtus* spp) are the major prey items (Ganey 1988). For quantitative studies complete descriptions and behavioral studies of prey species are necessary.

Neotoma

Rodents of the genus *Neotoma* are commonly called wood rats or pack rats (Olin 1954). They are primarily nocturnal, do not hibernate and are found in some form throughout the United States (Olin 1954, Hoffmeister 1971, Van Gelder 1982, Vaughan 1986). Wood rats resemble common house rats but have exceptionally large ears, a lightly furred tail, and long silky ears (Olin 1954).

Home ranges are usually under five acres, although males will travel more widely during the variable breeding season (Van Gelder 1982).

Live trapping of Neotoma can be done at anytime of year (Vaughan 1986). The preferred trap is a Sherman box trap (7.5 x 7.5 x 25 cm) (Pyc 1984, Vaughan 1986), although pitfall traps can be used (Taber and Cowan 1961, Block et al. 1988). Box traps can be purchased commercially; pitfall traps are made by burying buckets (Block et al. 1988, Szaro et al. 1988), or aluminum cans (Taber and Cowan 1961) in the ground. Traps should be baited with rolled oats and/or peanut butter; raisins or apple should be included for moisture in warm weather (Vaughan 1986). Curiosity bait, such as sparkling objects, can also be used (Taber and Cowan 1961).

Since wood rats are not regularly spaced a trapping grid may be ineffective in trapping the animal. It is suggested that traps be placed at entrances of dens (Vaughan 1986), which are easily identified by the large mounds of debris covering them (Olin 1954), or every 8 meters in places where activity is noted. Pyc (1984) defines activity as presence of dens, debris or droppings. Traps should be set at night and tended early in the morning to prevent mortality. Animals should be marked and released at point of capture (Pyc 1984, Vaughan 1986).

Peromyscus

Members of the genus *Peromyscus* are commonly called deer, cactus, or white-footed mice (Olin 1954, Reichman 1974, Mihok 1986). They are widely distributed throughout North America (Sullivan 1986), and can be found in every life zone in the Southwest (Olin 1954). Deer mice are strictly nocturnal and are active year round. Seasonal fluctuations have been noticed with populations peaking in summer (Olin 1954, Sullivan 1986, Vessey 1987). *Peromyscus* resemble house mice but are usually gray above with white under parts and feet, and possess extremely large ears and haired tails (Olin 1954). Home ranges vary with terrain, but average 0.13 hectares (Gottfried 1986), and a likely estimate for a population in an Arizona pine forest is 30-130 individuals (Smith and Sloan 1988).

Live trapping should be done during warmer months (Mihok 1986) when populations peak. The preferred traps are Longworth or Sherman box traps (Kitchings and Levy 1981, Gottfried 1986, Mihok 1986, Sullivan 1986, Adler and Wilson 1987, Smith and Sloan 1988). Pitfall traps are not recommended for mark-recapture studies as *Peromyscus* become trap shy (Taber and Cowan 1961). Effective baits include sunflower seeds, oats, peanut butter or any combination of the three. A wad of cotton should be added to decrease deaths due to cold (Kitchings and Levy 1981, Gottfried 1986, Mihok 1986, Sullivan 1986, Adler and Wilson 1987, Belk, Smith and Lawson 1988, Smith and Sloan 1988).

Grids for trapping are suggested that have a minimum size of 1.0 ha. The recommended spacing between trap station is 10-20 meters (Mihok 1986, Sullivan 1986, Belk et al. 1988, Smith and Sloan 1988), and traps should not be placed in exposed sites (Gottfried 1986). Trapping should be done overnight in summer because mice perish rapidly in metal traps. To insure ability to tend traps properly, a maximum of 100 traps per person per day is recommended (Sullivan 1986). Animals can be marked by toe clipping, ear notching, or ear tagging with fingerling fish tags, and released at point of capture (Kitchings and Levy 1981, Gottfried 1986, Mihok 1986, Sullivan 1986, Adler and Wilson 1987, Belk et al. 1988).

Microtus

The animals in the genus *Microtus* are commonly called voles or meadow mice (Caras 1967), and are widely distributed throughout North America (Sullivan 1986). They are typically small stocky creatures, with comparably large heads with small ears, and short legs. A primary distinguishing feature is their short (1-3 inches) furred tail (Caras 1967). Voles are active all day and year round throughout their range (Beacham 1986, Hilborn 1986), but there are large 3-4 year cyclic population fluctuations (Sullivan 1986). Activity is sometimes decreased on cold, clear nights (Bider 1968, Travers 1988).

Live trapping can be done in all seasons and the preferred traps to use are Sherman and Longworth box traps, or pitfall

traps (O'Farrell 1974, Randall 1979, Belk et al. 1988, Desy, Batzli and Jike 1989). Beacham (1986), Hilborn (1986), and Sullivan (1986) suggest a combination of pitfall and box traps. This is to ensure a more complete enumeration of the population as the former tends to trap smaller voles while the latter is suitable for larger animals.

Species of Microtus can be trap wary (Hilborn 1986), so prebaiting of box traps for one to two weeks is suggested (Beacham 1986, Sullivan 1986). Effective baits are oats, carrots or other vegetables, cracked corn, peanut butter, or any combination of the above. Cotton should be added to provide protection from low temperatures (O'Farrell 1974, Cole and Batzli 1978, Randall 1979, Beacham 1986, Hilborn 1986, Sullivan 1986).

Trapping grids (O'Farrell 1974, Cole and Batzli 1978, Sullivan 1986, Belk et al. 1988, Desy et al. 1989), or transect lines (Sullivan 1986) can be used. A minimum grid size of 0.5 ha is suggested by Sullivan (1986) with station intervals of 5-15 m (O'Farrell 1974, Cole and Batzli 1978, Sullivan 1986, Belk et al. 1988, Desy et al. 1989). As with other mice trapping should be done only at night in summer as voles will perish rapidly (Beacham 1986, Hilborn 1986, Sullivan 1986). Animals can be marked by toe clipping (Beacham 1986, Belk et al. 1988), but ear tagging with fingerling fish tags is preferred, and released at point of capture (Beacham 1986, Hilborn 1986, Sullivan 1986, Desy et al. 1989).

Summary

The literature reviewed suggested a strong spotted owl/old-growth relationship. The reason for this relationship is not known but several hypotheses have been proposed (Carey 1985, Gutierrez 1985). A number of researchers believe that prey base studies are high priority. Detailed habitat and behavioral information is necessary to conduct quantitative studies of the prey species.

METHODS

Old-Growth Definition

Old-growth forests are typified by well-developed, multi-storied canopies with tall dominant trees, numerous snags and an abundance of down logs and woody debris (Franklin et al. 1981). Quantitative values for components were obtained from a Region 3 draft of old growth standards for various cover types (Appendix A).

Site Selection

Radio-telemetry studies that were done on the Peaks Ranger District have yielded home range maps for spotted owls. The areas have been designated Spotted Owl Management Areas (SOMA). Two, the Weatherford Canyon SOMA (Fig.1) and the Schultz Creek SOMA (Fig.2), were chosen for this study. The choice was made because detailed home range maps, aerial photos, and other resource information was available for the areas. In addition the two SOMAS were at a short distance from Flagstaff.

One plot was randomly selected for study in each SOMA core and non-core area using a numbered dot grid placed on the aerial photographs. The plots (Fig.3 and 4) were located in the field and visually evaluated for old-growth characteristics. For this preliminary study, attempts were made to select old-growth areas. Sites lacking old-growth characteristics were rejected and new ones randomly selected.

Prey Determination

The primary prey species of the Mexican spotted owl were determined to be of the genera Peromyscus, Neotoma, and Microtus, based on their percentage of 1193 total prey items (Ganey, 1988). A literature review of the genera was done to determine proper live-trapping techniques and appropriate population estimators.

Trapping Design

Each 1.0 ha site was trapped by using a 10 X 10 grid of 100 8 X 8 X 20 cm Sherman live traps. Grids were oriented in the cardinal directions. Traps were placed at 11.1 meter intervals, within 2 meters of the trap station, near trees, rocks or logs. Traps placed in the open were covered with grass or litter. Traps were baited with rolled oats, peanut butter and sunflower seed, and a piece of cotton was placed in each trap for bedding. Each site was trapped for seven nights from August 4 to September 2, 1990 with traps set after 4:00 pm and tended early in the morning. This trapping design was chosen for the following reasons:

1. Call (1982) suggests a minimum of 500 trap nights. Seven trapping occasions with 100 traps, minus the number of traps not counted (tripped but empty) met those recommendations.

2. White et al. (1982) recommended a design which would provide 4 traps per home range. This computes to a trap station interval of less than 15 meters for the species in this study.

3. White et al. (1982) also recommended a minimum of 5 trapping occasions, with 7-10 preferred. Seven was chosen because a longer trap session could increase the accuracy of the population estimator. This design meets

the minimum, has an adequate number of trap sessions, and is sufficiently short to meet the assumption of random trappability (i.e. short enough to disallow trap responsiveness).

4. One ha minimum plot size was recommended by a number of sources, primarily Sullivan (1986), for all genera concerned.

5. The bait selected was recommended by all sources reviewed.

6. One hundred traps were set per night as the maximum number for one person to tend adequately.

7. Increased mortality occurs when traps are not checked early in the morning, or do not contain cotton or some other form of bedding (Call 1982,1986, Sullivan 1986).

8. Ear tagging is less invasive than toe-clipping and other forms of mutilation. There should be decreased trap response (trap shyness) due to the decreased trauma to the animal.

Trapped animals were marked with 1 numbered fingerling fish tag (Seattle, WA) in the right ear and released at point of capture. Tag number, genus and trap number were recorded.

Population analysis

Trap data were analyzed using a modified Jolly-Seber estimator (Ricker 1975) due to the small sample sizes obtained. Core area samples were compared to determine if there were differences within cores, then they were compared to non-core areas to determine differences between the two. The null hypotheses for this project were:

1. There are no significant differences in rodent populations between core areas.

2. There are no significant differences in rodent populations between non-core areas.

3. There are no significant differences in rodent populations between core and non-core areas.

If H_o 1 and 2 are accepted, population stability within core and non-core areas will be assumed. This will allow for comparison between use areas (core vs non-core). Rejection of the 3rd H_o will indicate that rodents are more numerous in one use area and will either support or oppose the abundance theory.

Stand Analysis

A 0.1 ha area was inventoried for plot description. Ten 0.01 ha subplots were randomly selected without replacement and evaluated according to the number and length of down logs; number, diameter at breast height (dbh), and age of live trees greater than 18 in dbh; number, height and dbh of standing dead trees; number of trees less than 6.0 in dbh; and number of trees greater than 6.0 in dbh. These criteria were chosen based on Franklin et al. (1981) and a Region 3 draft of old-growth standards for various forest cover types (Appendix A).

Each subplot measured 10 x 10 m and was centered at the appropriate trap station (Figure 5). The inventory was made using a standard compass, clinometer, diameter tape, 100 ft tape and an increment borer. General photographs were taken in each inventory area.

RESULTS

Area Inventory

Schultz Creek SOMA Plot 1 was dominated by the mixed conifer and ponderosa pine (Pinus ponderosa) forest type. The primary overstory species were Douglas-fir (Pseudotsuga menziesii) and ponderosa pine. The understory was composed of white fir (Abies concolor), limber pine (Pinus flexilis), Douglas-fir and ponderosa pine. Grass species present included Aristida species, mountain muhly (Muhlenbergia montana), Bromus spp. and Arizona fescue (Festuca arizonica). Plot 2 was mainly ponderosa pine with a scattered understory component of Douglas-fir and white fir. Arizona fescue and mountain muhly were the dominant grasses.

Weatherford Canyon Plot 1 was more single storied and meadowy than the others. Ponderosa pine was the dominant overstory and understory species. Both stories had a scattered limber pine component. Grasses included Arizona fescue, mountain muhly, Aristida spp, and Agropyron sp. Plot 2 was a mixed conifer and ponderosa pine type, resembling Schultz Creek Plot 1 in tree species composition. There was no significant grass component present.

Description of the plots, based on the inventory attributes in Appendix A, showed that only two met the minimum criteria. Schultz Creek Plot 2 and Weatherford Canyon Plot 2 contained an acceptable number of specific quality trees (Table 1). Frequency histograms (Figures 6 and 7) show that:

1. In the Schultz Creek SOMA, Plot 2 (the core plot) contained more live trees and down logs than Plot 1.

2. In the Weatherford Canyon SOMA, Plot 2 (the non-core plot) contained more live trees and an equal amount of snags.

Estimation of Prey Abundance

Total trap nights and genera trapped varied from site to site (Table 2), with *Peromyscus* spp. being the animal most trapped. *Peromyscus* populations and percent recaptures were calculated for each plot (Table 3). Insufficient animals were captured to allow statistical analysis for comparisons, but a simple graph of animal numbers (Figure 8) shows that *Peromyscus* were not more abundant in core areas.

DISCUSSION

Prey Estimates

Numbers and genera of animals trapped were small in this pilot study. Low trap success can be due to low populations of the animal or poor trapping technique but recommended field procedures were followed. The recapture rate was 38% on average (Table 3) and only two individuals were retrapped in the same trap. This indicates a fairly non-traumatic trap experience and little trap responsiveness. A likely reason for the low trap success is that the animals were in low numbers.

The small variability in genera trapped was probably due to focus on old growth areas. Microtine rodents inhabit a more open canopied, meadowy habitat. Woodrats are found primarily in areas of rocky cliffs and outcrops. Neither of these habitats was well sampled in this study.

Prey animals were not more abundant in the Weatherford Canyon core area. This was not expected, and could be due to the habitat quality of the sample area. The area sampled in the core did not meet minimum old growth requirements. Inferences can be made that the sample core area contained less favorable Peromyscus habitat than the non-core area.

Area Analysis

Visual quantitative estimation in the field indicated all plots met minimum old growth criteria. Inventory showed only two actually met the minimum requirements. This could be due to the

0.10 ha inventory area or inaccurate field observation. Inventory of the area could be done before trapping, or a larger sample area could be used to more accurately describe sample plots.

PLANNED RESEARCH

Trapping will be done May-August 1991 on the Schultz Creek and Weatherford Canyon SOMA's. May was selected as the start date to allow adequate juvenile dispersal. No trapping will be done in late August. The increased human activity due to hunting season disrupted trapping procedures and resulted in lost traps.

Trapping Design

Plot and site selection methods will be the same as those used in the 1990 pilot study. A similar trapping design will be used, but the following changes made be made subsequent to a preliminary trapping period:

1. Traps may not be baited with peanut butter. Peanut butter attracts both Peromyscus and ants. Absence of peanut butter may increase the possibility of trapping other genera. It may also decrease the occurrence of ants and possible animal mortality. There were two trap deaths attributed to presence of ants.

2. Non-old growth areas will be trapped. This will depend on the objectives of Coop agreement No. 28-CO-538, but may decrease the bias towards Peromyscus and give a more accurate view of the prey base.

3. Animals will be marked in both ears. This will decrease the possibility of lost marks.

Inventory Methods

Inventory methods will be changed. All trees on the 0.01 hectare plots will be measured. DBH and height will be determined. Trees will not be aged. A line transect inventory will be conducted to determine the frequency distribution of grasses, forbs, rocks and trees for each sample area. Twenty

0.01 areas may be sampled to increase the accuracy of plot descriptions. The inventory will be completed prior to trapping on the plot, or after the trapping ends.

Statistical Analysis

Populations will be estimated using the Jolly-Seber formulas because they allow for calculation of standard errors. Modifications will be used if necessary. Analysis of variance (ANOVA) will be used to describe differences within and between core and non-core areas.

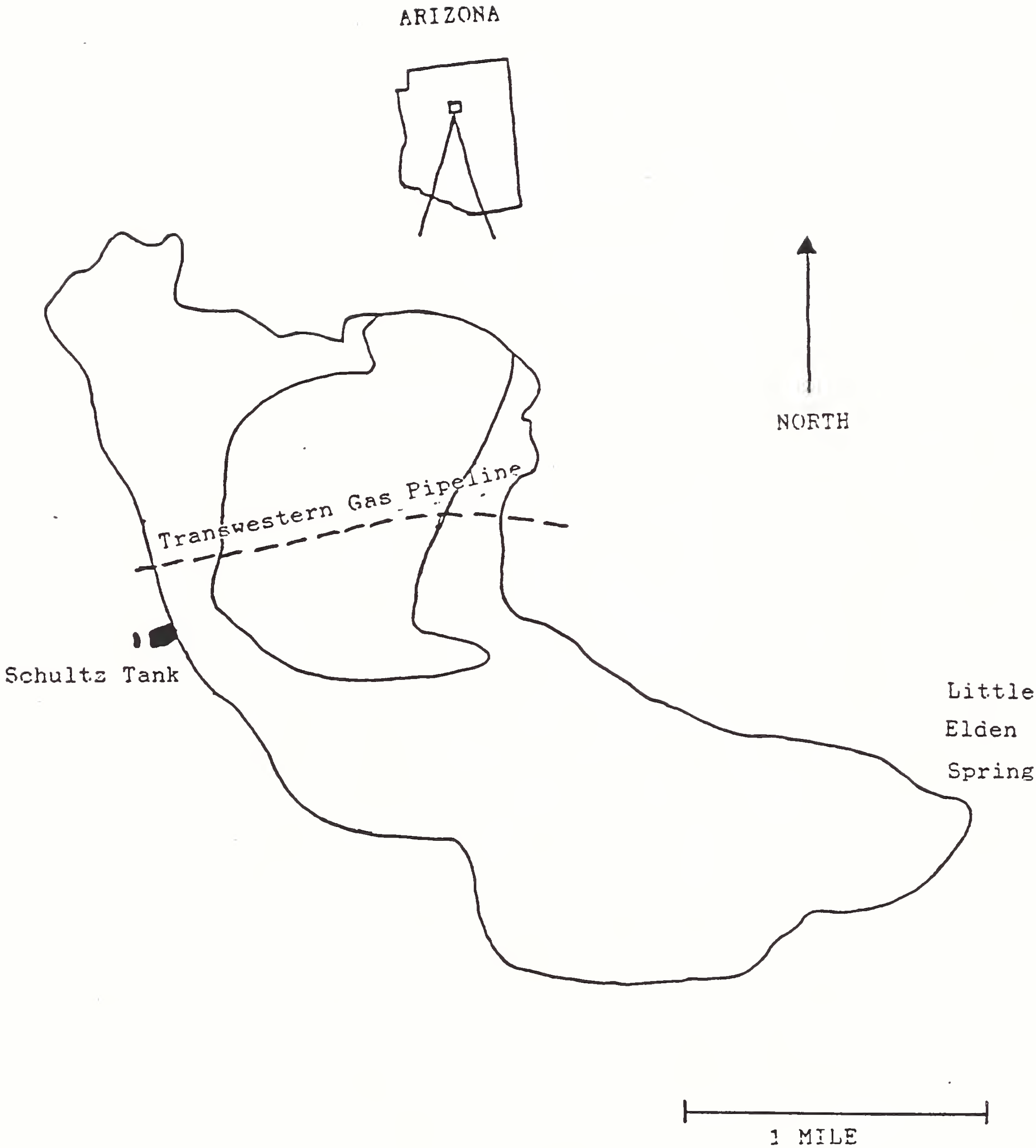

Figure 1. Weatherford Canyon spotted owl home range map with identified core area.

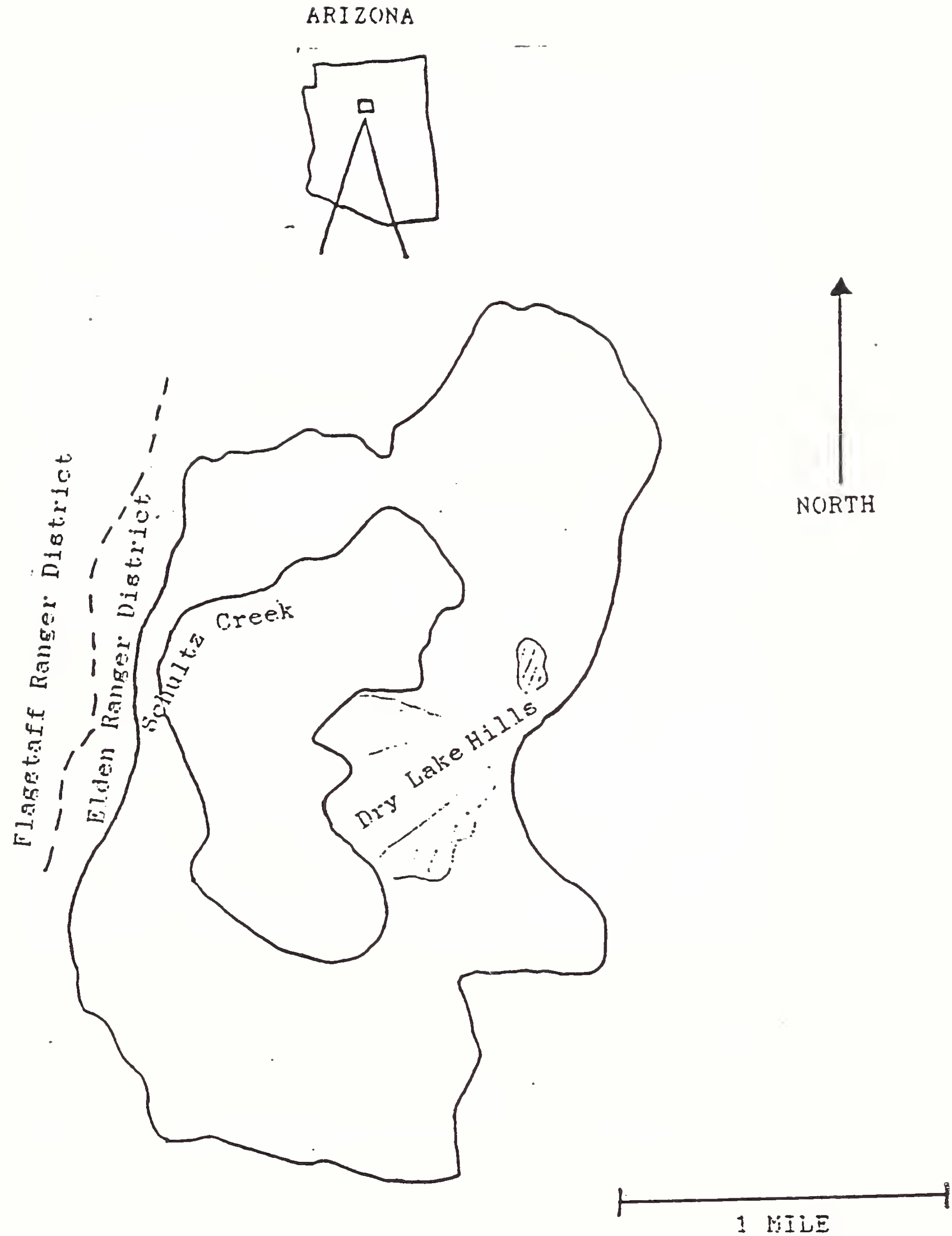

Figure 2. Schultz Creek spotted owl home range map with identified core area.

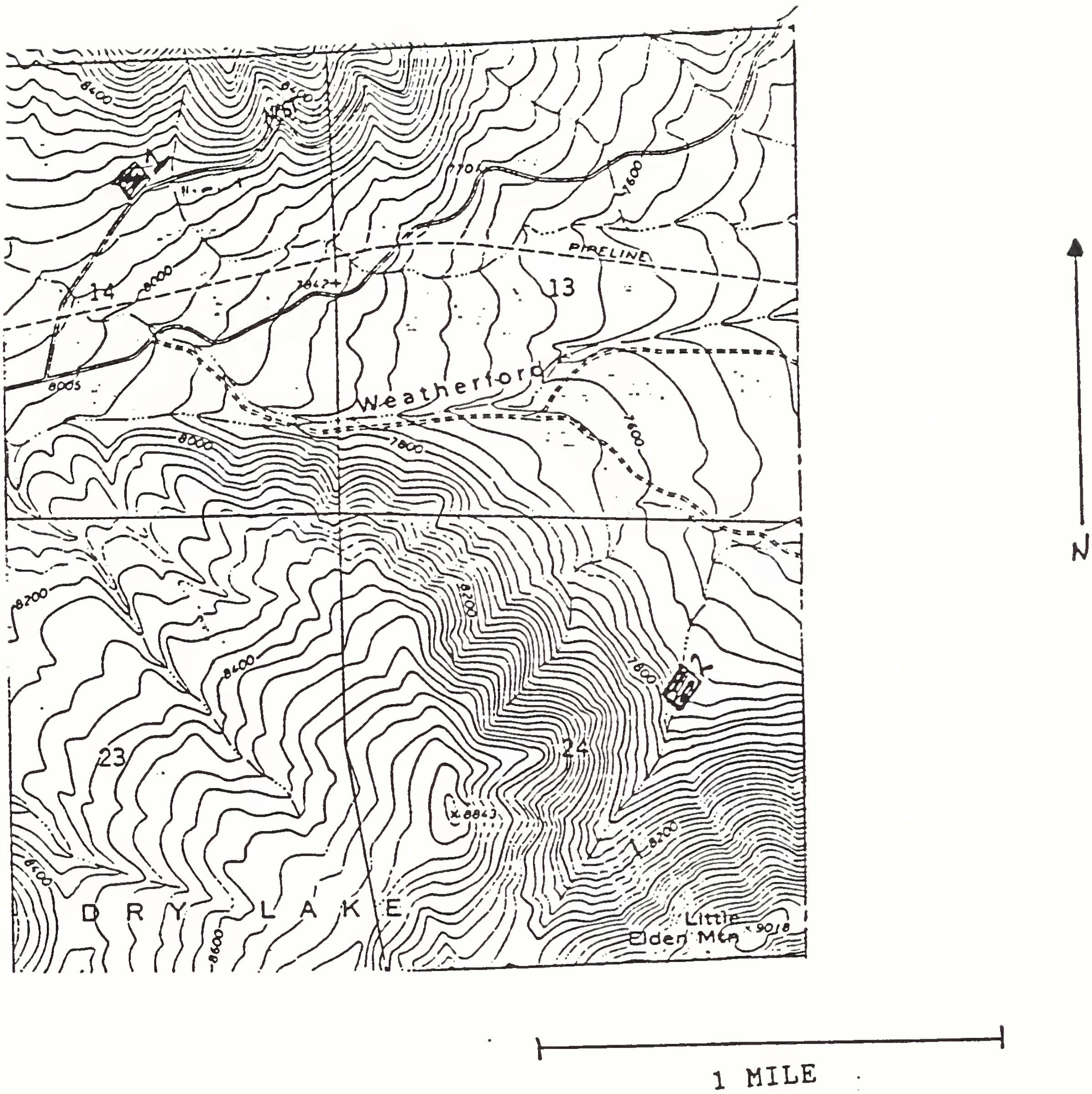

Figure 3. Location of study sites with the Weatherford Canyon SOMA.

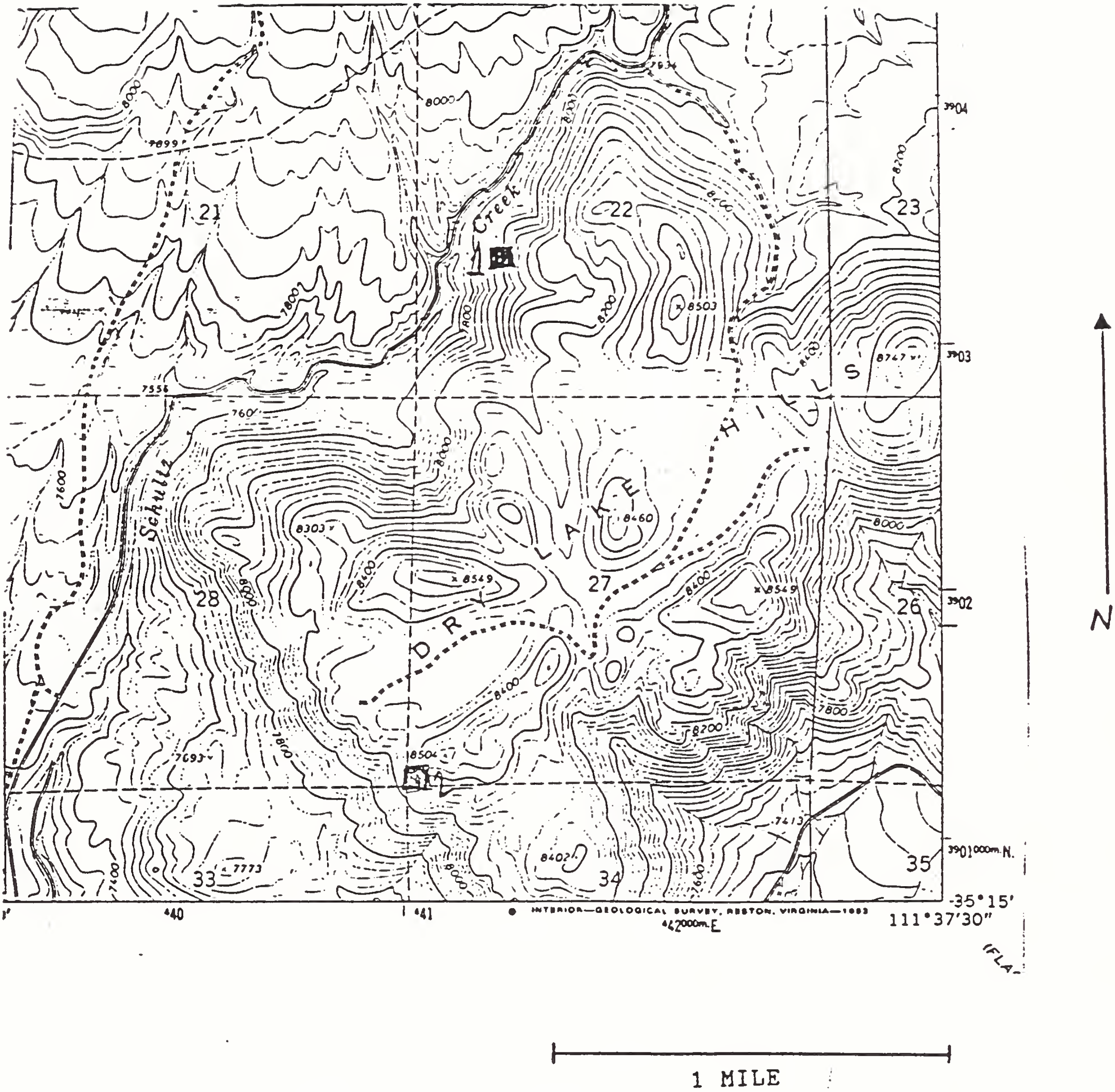

Figure 4. Location of study sites within the Schultz SOMA.

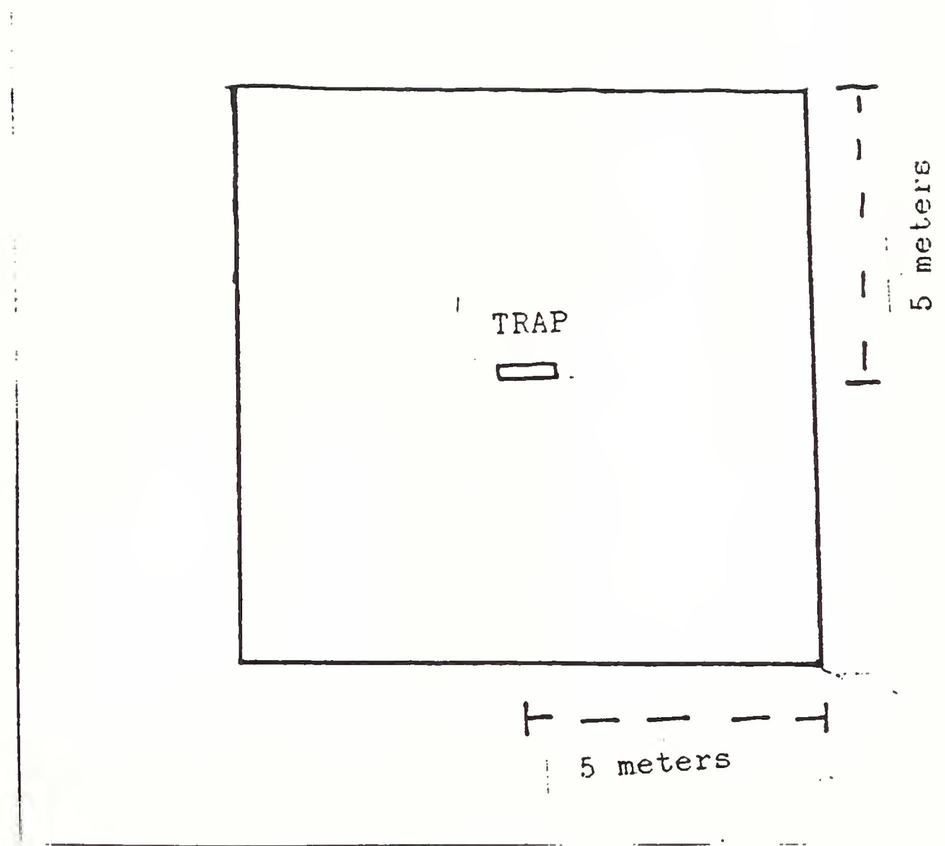

Figure 5. Placement of inventory subplots around trap station.

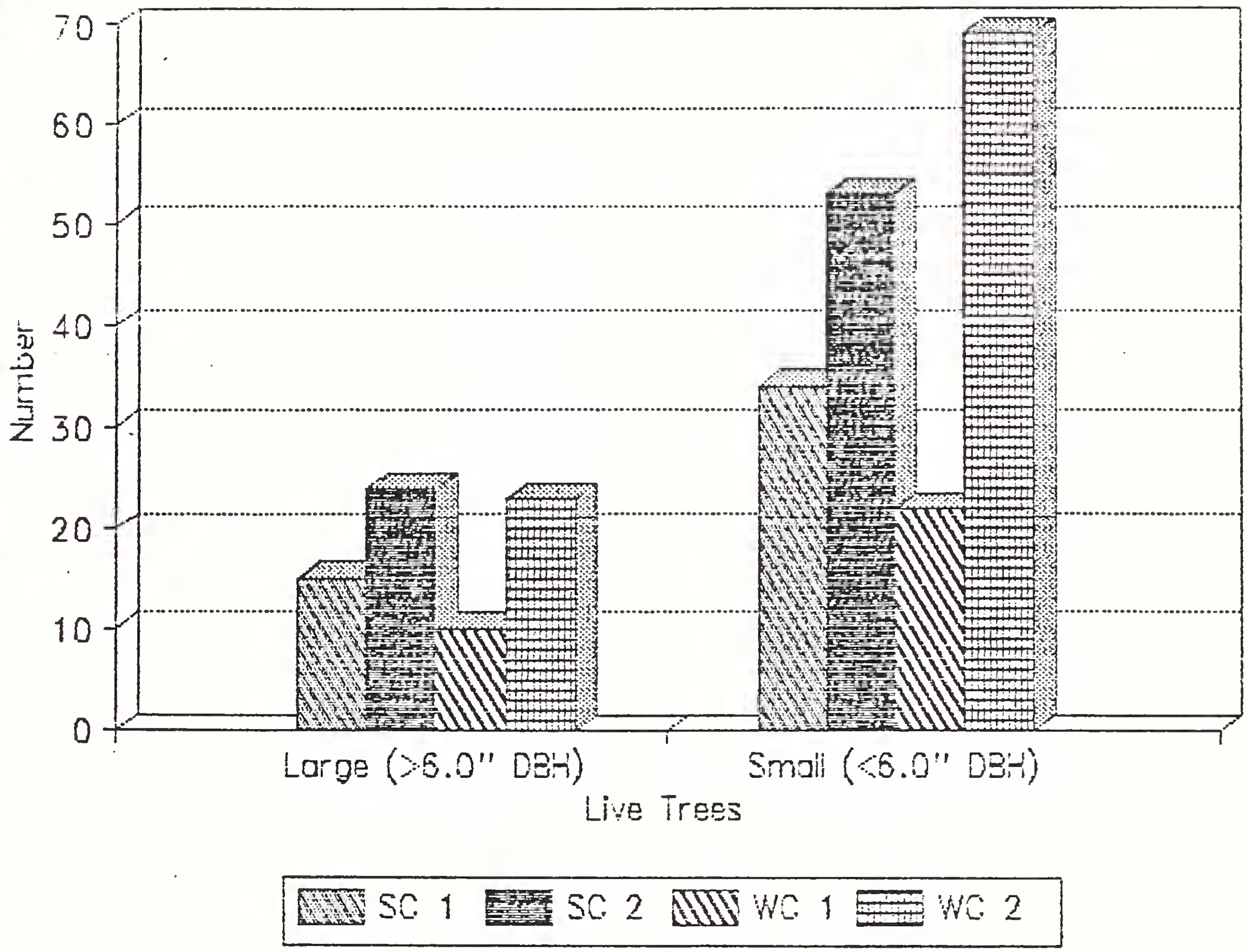

Figure 6. Per plot frequency distribution of live trees.

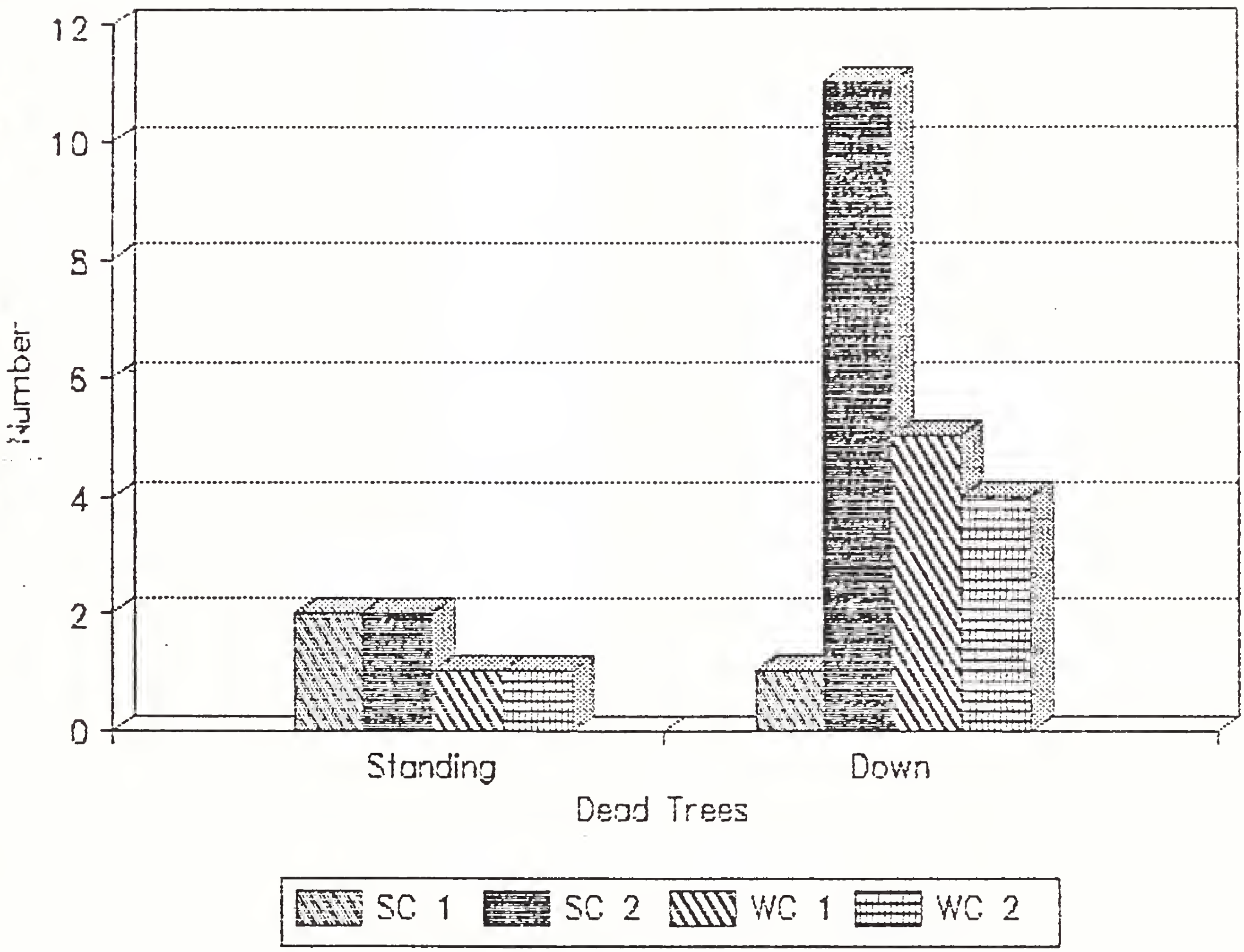

Figure 7. Per plot frequency distribution of dead trees.

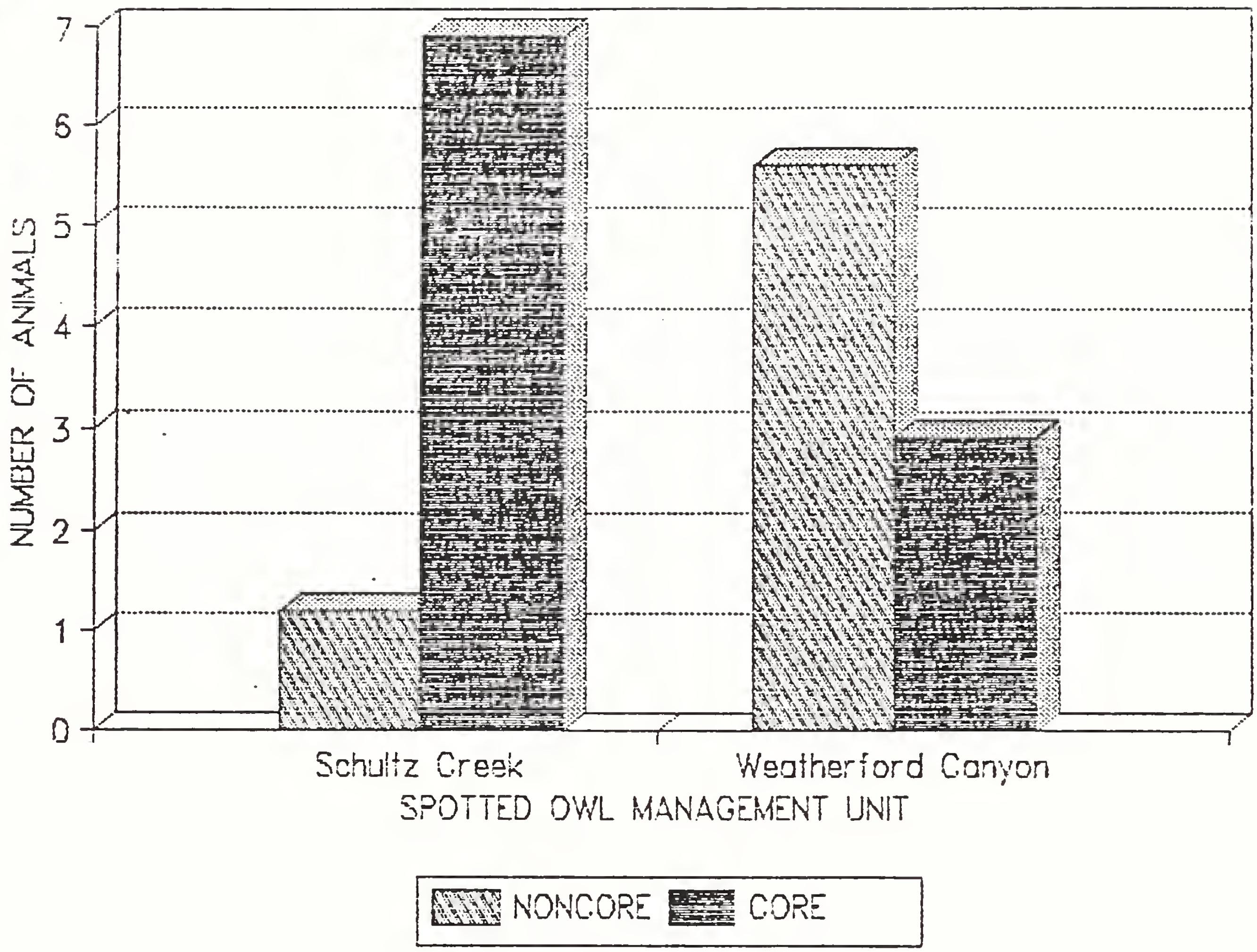

Figure 8. Numbers of *Peromyscus* by habitat type and SOMA.

Table 1. Inventory data based on minimun old growth attributes.

SOMA	Type	No. of Live Trees/ha	No. of Down Logs/ha	No. of Snags/ha
Schultz Creek 1	NC	20	20	10
Schultz Creek 2	C	40	40	20
Weathrfrd Cnyn 1	C	0 ^	40	10
Weathrfrd Cnyn 2	NC	50	15	10

^ None in 0.01 ha inventory met minimum criteria

Table 2. Taxomonic and trappind data for 1990

SOMA	Type	Genus of Trapped Animals	Number Trapped	Total No. of Trap Nights
Schultz Creek 1	NC	*Peromyscus*, *Neotoma*	6,1	681
Schultz Creek 2	C	*Peromyscus*, *Neotoma*	18,2	597
Weathrfrd Cnyn 1	C	*Peromyscus*	5	675
Weathrfrd Cnyn 2	NC	*Peromyscus*	11	618

Table 3. Percent recaptures and Jolly-Seber population estimates for the 1990 trapping season.

SOMA	Type	Population Estimate (avg. over trapping period)	Percent Recaptures
Schultz Creek 1	NC	1.20	29
Schultz Creek 2	C	5.60	33
Weathrfrd Cnyn 1	C	2.93	60
Weathrfrd Cnyn 2	NC	6.91	28
			avg=38

C = Core

NC = Noncore

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APPENDIX A

Old-Growth Attributes

Structure

The following attributes are the minimum acceptable criteria for threshold old-growth in the ponderosa pine forest cover type.

	Site Production Potential (Site index break between low and high = 55) Low	High
1. Live Trees		
a. Large		
Number/ac	20 @ 14 or 12 @ 18	20 @ 20 or 14 @ 24
Size (dbh)	14 / 18	20 / 24
[1]Age	150	160
BA (sq ft/ac)	60	110
b. Canopy Cover (%) (all live trees)	45	60
2. Dead Trees		
a. Standing		
Number/ac	1.8	1.8
Size (in dbh)	14	14
Height (ft)	15	35
b. Down logs		
Number/ac	2	2
Size (in dia)	12	12
Length (ft)	15	16

[1]Stand average must be 120 years (sawtimber class).

Height: The total span of a dead standing tree measured in feet from ground level along the bole on the uphill side of the tree to the tip of the tree, if merchantable. For nonsound dead trees with broken tops, height is measured to the broken top and the missing portion is ignored.

Down Logs: Dead trees that are lying on the forest floor. They may be in tree length or broken into several sections.

Size (dia): The measured diameter of a down log recorded in inches. If a broken section of the top of a tree, the measured diameter is at the large end of the down log.

Length (ft): The measured distance in feet from one broken end of a down log to the other end.

Ponderosa Pine Forest Cover Type

Ponderosa pine has been referred to as blackjack and yellow pine in the past. The term blackjack indicated a younger ponderosa pine with dark gray to black bark characteristics. The blackjack's bark is deeply furrowed with narrow ridges between the fissures. In contrast the term yellow pine was used to indicate an older tree. The older yellow pine's bark is reddish brown to yellow, carrying the color well into the top of the tree; the plates are usually very wide, long and smooth. The bark color transition begins sometime between 120-150 years of age, depending upon the geographic location.

The dominant tree species in the ponderosa pine forest cover type is ponderosa pine. Minor tree species of pinyon pine and juniper occur at the lower elevations adjacent to the pinyon-juniper forest cover type. At the higher elevations near the mixed-species group, Southwestern white pine and Gambel oak can be found in abundance, and frequently small amounts of Douglas-fir, white fir, and aspen are present. Alligator juniper is found with ponderosa pine along the Mogollon Rim, both above and below the rim.

Tree growth is related to soil or site productivity. Soil productivity is determined by measuring the age and height of several dominant or codominant good growing trees and comparing the measurements with the appropriate site index table. A site index of 55 was established as a breaking point between the low and high sites for the structural attributes.